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IN THE U.S. PATENT AND TRADEMARK OFFICE

In re application of

Before the Board of Appeals

Shigeto FUJIMURA et al.

Appeal No:

Application No: 09/753,662

Group: 1765

Filed: January 4, 2001

Examiner: M.A. Anderson

Conf: 1881

For: PROCESS FOR PRODUCING COMPOUND SEMICONDUCTOR  
SINGLE CRYSTAL

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IN THE U.S. PATENT AND TRADEMARK OFFICE

## BRIEF ON BEHALF OF APPELLANTS

Sir:

**(1) REAL PARTY IN INTEREST**

320.00 OP

**(2) RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences.

**(3) STATUS OF THE CLAIMS**

Claims 1-12 are pending in the application. Claims 5-10 and 12 are withdrawn from consideration and Claims 1-4 and 11 stand rejected per the Final Office Action of August 27, 2002.

**(4) STATUS OF THE AMENDMENTS**

The Reply to an Office Action filed June 26, 2002 amended claim 1 and added new claims 2-12. All amendments have been entered as of the Final Office Action of August 27, 2002.

**(5) SUMMARY OF THE INVENTION**

The present invention is directed to a process for producing a compound semiconductor single crystal which comprises placing the raw material into a crucible, encapsulating the material, setting the crucible in a vertical heating furnace to heat the raw material, melting the material, promoting a nucleation on the surface of a raw material melt by leaving a solid raw material in a part of the raw material melt, solidifying the raw material melt without a seed crystal and

growing the crystal by using a nucleus generated by the nucleation.

**(6) ISSUES FOR CONSIDERATION**

A. Whether the Examiner has established a prima facie case of obviousness under 35 U.S.C. §103(a) over Fukuda et al. U.S. Patent 5,554,219 in view of Dutta et al. U.S. Patent 6,273,969 when the Examiner has not pointed to any disclosure or suggestion of each and every element of the present invention within the cited references and when the Examiner has failed to show an objective teaching within the references or in the art that would motivate one of ordinary skill in the art to combine the cited references to arrive at the present invention.

B. Whether the Examiner has established a prima facie case of obviousness under 35 U.S.C. §103(a) over Fukuda et al. U.S. Patent 5,554,219 in view of Dutta et al. U.S. Patent 6,273,969 and further in view of Taniguchi et al. U.S. Patent 5,603,763 when the Examiner has not pointed to any disclosure or suggestion of each and every element of the present invention within the cited references and when the Examiner has failed to show an

objective teaching within the references or in the art that would motivate one of ordinary skill in the art to combine the cited references to arrive at the present invention.

**(7) GROUPING OF THE CLAIMS**

I. Claims 1-3 and 11.

II. Claim 4.

**(8) ARGUMENTS ON THE ISSUES**

A. No Prima Facie Case of Obviousness

The Examiner has failed to make a prima facie case of obviousness, as the Examiner has not pointed to the disclosure or suggestion of each and every element of the present invention as defined by the broadest claim, Claim 1. Moreover, the Examiner has failed to point to a clear objective teaching within the secondary reference or in the field of knowledge that would motivate one of ordinary skill in the art to combine the cited references.

1. Failure to Disclose or Suggest Each and Every Limitation.

According to In re Lowry, 32 USPQ2d 1031, 1035, 32 F.3d 1579 (Fed Cir 1994), a prima facie case of obviousness is established if a cited reference explicitly or inherently

discloses or suggests each and every limitation of the claimed invention. The Examiner bears the burden of establishing a prima facie case of obviousness. In re Rijckaert, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). Appellants submit that the Examiner has failed to establish a prima facie case of obviousness.

The Examiner attempts to establish a prima facie case of obviousness in Paper No. 14, page 2, paragraph No. 2. The Examiner states that it would have been obvious to one of ordinary skill in the art to arrive at the present invention because U.S. Patent 5,554,219 to Fukuda et al. (hereinafter "Fukuda '219") discloses a delineated process using a VF or VGF furnace in which crystal growth would occur via "nucleation growth" between a raw material, which is melted and a solid portion of the raw material, which has been twice melted. The Examiner states that the process disclosed in Fukuda '219 is identical to the claimed process of claim 1, except that Fukuda '219 fails to encapsulate the raw material as required by the claim limitation. However, the Examiner relies on U.S. Patent 6,273,969 to Dutta et al. (hereinafter Dutta '969) for disclosing using an encapsulant. The Examiner concludes that the combination of Fukuda '219 and Dutta '969 discloses all the elements of the process of claim 1.

Appellants submit that the Examiner's understanding of Fukuda '219 is technically and factually incorrect. Fukuda '219 discloses six different embodiments for producing a single crystal bulk ZnSe. The first through the fourth and sixth embodiments of Fukuda '219 use a seed crystal to process the single crystal bulk ZnSe. These embodiments of Fukuda '219 are clearly distinguished from the present invention in that they require a seed crystal and the present invention explicitly excludes using a seed crystal.

The fifth embodiment of Fukuda '219, which does not use a seed crystal, is the closest embodiment to the claimed invention. The fifth embodiment of Fukuda '219 produces polycrystalline ZnSe from a ZnSe melt using a high pressure melt technique. After temporary interruption of the growth of the crystal, part of the polycrystalline ZnSe is remelted, followed by growing of a single crystal on the remelted portion of the polycrystalline ZnSe, which is adjacent to the remaining solid portion of the polycrystalline ZnSe. A large number of nuclei are generated and then a single crystal is obtained by selective growth. The nucleation occurs on the contact surface between the polycrystal and the melt.

The following diagram demonstrates the differences between the 5<sup>th</sup> embodiment of Fukuda '219 and the present invention.



The diagram, which was previously submitted as an attachment to the Reply filed June 26, 2002, shows a five step process. The steps are (1) melting the raw material in a crucible, (2) allowing a polycrystal to form on the bottom of the crucible, (3) partially remelting the formed polycrystal, (4) nucleation taking place on the bottom surface of the raw material adjacent to the polycrystal and (5) forming the single crystal on top of the polycrystal, where the single crystal is grown from the bottom of the crucible to the top.

On the other hand, as demonstrated in the diagram the present invention comprises adding the raw material to the crucible, encapsulating the raw material, melting the raw material that is encapsulated, allowing the melt to partially solidify on the bottom while nucleation takes place on the top surface of the melt just below the encapsulant, and growing the crystal from the top downward.

Fukuda '219 fails to disclose or suggest nucleation that occurs on the surface of the melt just below the encapsulant. Fukuda '219 does not even disclose or suggest using an encapsulant. Fukuda '219 also fails to disclose solidifying the melt gradually from the surface of the melt. As such, Appellants submit that Fukuda '219 fails to disclose or suggest process steps b), e) and f) of the present invention as claimed in claim 1.

The Examiner recognizing at least one of the numerous deficiencies of Fukuda '219, further relies upon the teachings of Dutta '969 in an attempt to suggest the present invention.

Dutta '969 discloses a process for making alloys of semiconductors including ZnSe by VF methods and by using an encapsulant such as B<sub>2</sub>O<sub>3</sub>. However, Dutta '969 does not disclose or suggest nucleation that occurs on the surface of the melt just below the encapsulant. Dutta '969 also does not disclose or suggest solidifying the melt gradually from the top surface of the melt. Appellants submit that Dutta '969 fails to disclose or suggest process steps e) and f) of the present invention.

Therefore, even the combination of Dutta '969 and Fukuda '219 (assuming that there is some objective teaching to combine the references) fails to disclose or suggest all of the elements of the process recited in claim 1. Steps e) and f) are never disclosed or suggested by the combination of the references. As such, the Examiner has failed to meet the burden of establishing a prima facie case of obviousness as required by In re Lowry, supra, to point to the disclosure or suggestion of each and every limitation of the claimed invention. As such, the rejection should be reversed on this basis alone.

## 2. No Motivation To Combine the References

The Examiner has also failed to establish a prima facie case of obviousness by failing to establish that one of ordinary skill in the art would be motivated to combine Fukuda '219 and Dutta '969 to arrive at the present invention as defined by the broadest claim, Claim 1.

According to In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988), a prima facie case of obviousness is established when the Examiner shows that some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the cited references. The Examiner has failed to make such a showing.

Moreover, it is not prima facie obvious to modify a reference unless the secondary references suggest an advantage to be gained from the modification. See In re Sernaker, 217 USPQ 1, 6 (Fed. Cir. 1983). The cited references must suggest the desirability of the modification. In re Brouwer, 37 USPQ2d 1663, 1666 (Fed. Cir. 1995).

Fukuda '219 does not suggest or even hint at using an encapsulant or having nucleation occur on the surface of the melt. In fact, in Fukuda '219 nucleation occurs at the bottom on the melt. This is demonstrated in the diagram, supra.

Dutta '969 does not suggest any advantage to be gained by making the Examiner's proposed modifications of using the

encapsulant of Dutta '969 with the method disclosed in Fukuda '219.

The Examiner asserts that one of ordinary skill in the art would be motivated to combine the disclosure of Dutta '969 with the disclosure of Fukuda '219, because Dutta '969 discloses making alloys of semiconductors by using an encapsulant with the VF method. The Examiner asserts that one of ordinary skill in the art would be motivated to combine the references to produce a semiconductor alloy of constant stoichiometry.

Appellants submit that the Examiner is using impermissible hindsight to reconstruct the present invention. The Examiner merely relies on Appellants' own teachings to form the obviousness rejection. The Examiner has taken the present invention and simplified it and divided it into separate steps, i.e., encapsulating the raw material, melting the raw material, nucleation and solidifying the raw to form the crystal. The Examiner in an attempt to make a prima facie case of obviousness searched for the simplified steps in separate references. However, none of the references suggest combining the steps to arrive at the present invention. Such hindsight reconstruction is impermissible according to MPEP 2141 and In re Deminski, 796 F.2d 436, 443 230 USPQ 313, 316 (Fed. Cir. 1986).

At best, the Examiner has pointed out a combination of references that make it "obvious to try" to attain the claimed

invention. "Obvious to try" is not the standard under which to reject claims under 35 USC 103. See In re Dow Chemical Co., 5 USPQ2d 1521, 1532 (Fed. Cir. 1988) (rejecting the "obvious to try" standard). As such, Appellants submit that the Examiner has not established a prima facie case of obviousness and the rejection should be reversed.

B. No Prima Facie Case of Obviousness

The Examiner has failed to make a prima facie case of obviousness, as the Examiner has not pointed to the disclosure or suggestion of each and every element of the present invention as defined by claim 4 within the teachings of Fukuda '219, in combination with Dutta '969 and U.S. Patent 5,603,763 to Taniguchi et al. Moreover, the Examiner has failed to show a clear objective teaching that would motivate one of ordinary skill in the art to combine the cited references.

1. Failure To Disclose or Suggest Each and Every Element

Appellants submit that all of the elements of claim 4 are neither disclosed nor suggested by the combination of disclosures from Fukuda '219, Dutta '969 and Taniguchi '763, particularly steps e) and f).

Appellants rely on the arguments above regarding the teachings and deficiencies of Fukuda '219 and Dutta '969 and incorporate the arguments by reference thereto. Further,

Taniguchi '763 discloses a method of making a single crystal of a semiconductor where the raw material is placed in a crucible, which is vacuum sealed and heated to a particular temperature to melt the raw material. The crystal is grown from the surface of the melt by nucleation. However, Taniguchi '763 fails to disclose an encapsulating step (e.g. step b), and a top downward solidifying step (e.g. step f). Therefore, the combination of Fukuda '219, Dutta '969 and Taniguchi '763 (assuming there is motivation to combine the references) fails to disclose or suggest all the elements of the claimed invention, particularly step f.

For the foregoing reasons, Appellants respectfully request that the rejection over claim 4 be reversed on this basis alone.

2. No Motivation To Combine Fukuda '219, Dutta '969 and Taniguchi '763.

Appellants submit that the Examiner has also failed to establish that one of ordinary skill in the art would be motivated by some objective teaching within the cited references or in the field of knowledge to combine Fukuda '219, Dutta '969 and Taniguchi '763 to arrive at the invention of claim 4.

Appellants rely on the arguments above regarding the absence of any teachings to combine Fukuda '219 and Dutta '969. As such, the arguments are hereby incorporated by reference

thereto. Appellants also submit that Taniguchi '763 fails to motivate one of ordinary skill in the art to combine the references to arrive at the invention of claim 4. Taniguchi '763 does not disclose or suggest using an encapsulant. As such, Appellants submit that one of ordinary skill in the art would not be motivated to modify Fukuda '219 from the disclosure in Taniguchi '763 to arrive at the invention of claim 4.

As such, Appellants respectfully request that the rejection of claim 4 be reversed.

#### C. Conclusion

For the foregoing reasons, it is respectfully submitted that all claims in this application are allowable. Favorable reconsideration by the Honorable Board of Patent Appeals and Interferences is respectfully solicited.

If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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ATTACHMENT: APPENDIX-Claims On Appeal



(9) APPENDIX

CLAIMS ON APPEAL

1. A process for producing compound semiconductor single crystal, comprising the steps of:

- a) placing a compound semiconductor raw material into a crucible;
- b) encapsulating the raw material;
- c) setting the crucible in a vertical type of a heating furnace to heat the raw material;
- d) melting the raw material;
- e) promoting a nucleation on a surface of a raw material melt by leaving a solid raw material in a part of the raw material melt;
- f) solidifying the raw material gradually from the surface of the raw material melt without a seed crystal; and
- g) growing a crystal by using a nucleus generated by the nucleation.

2. The process of claim 1, wherein the raw material is ZnTe or CdTe.

3. The process of claim 1, wherein  $B_2O_3$  is used to encapsulate the raw material.

4. The process of claim 1, wherein nucleation occurs on a top surface of raw material melt.

11. The process of claim 1, wherein nucleation occurs on a surface adjacent to the raw material melt.